NASA Habitation Work at KSC
UCF Space Day
March 13, 2013

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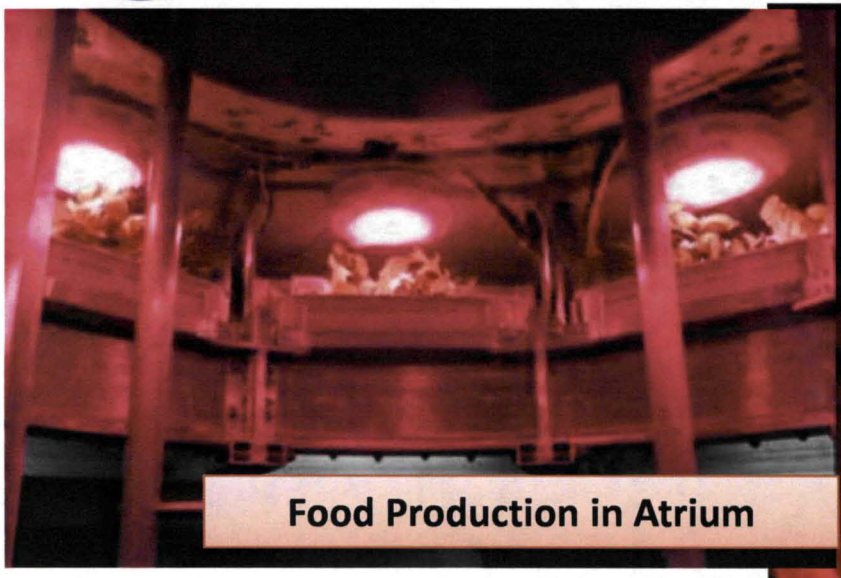
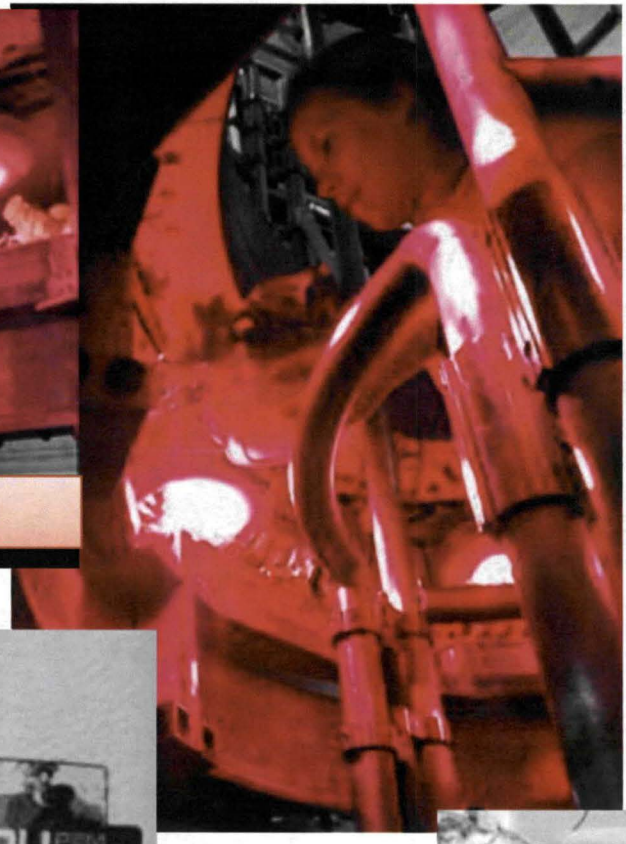
Deep Space Habitat Concept Demonstrators

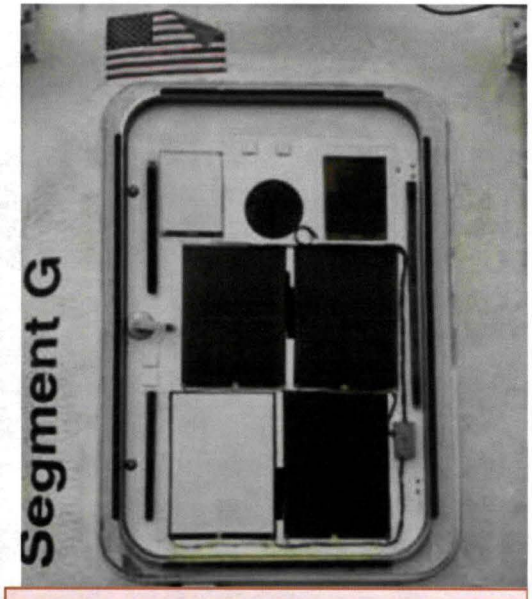
- Deep Space Habitat concepts mature under Advanced Exploration System Program – Habitat Systems Project
- Current Project web page
  - http://www.nasa.gov/exploration/technology/deep_space_habitat/index.html
- X-Hab Academic Innovation Challenge
  - http://www.spacegrant.org/xhab/
- Concept Demonstrators
  - Habitat Demonstration Unit – DSH at JSC (transferred to Human Research Program for human factors studies)
  - ISS-derived DSH under development at MSFC

Habitat System Technology Demonstrations

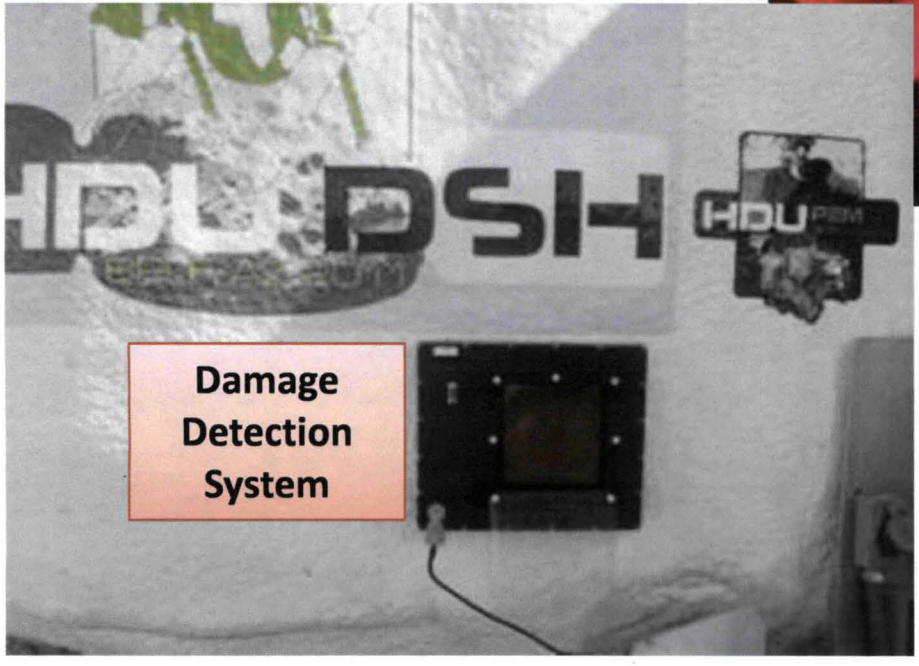


Food Production in Atrium





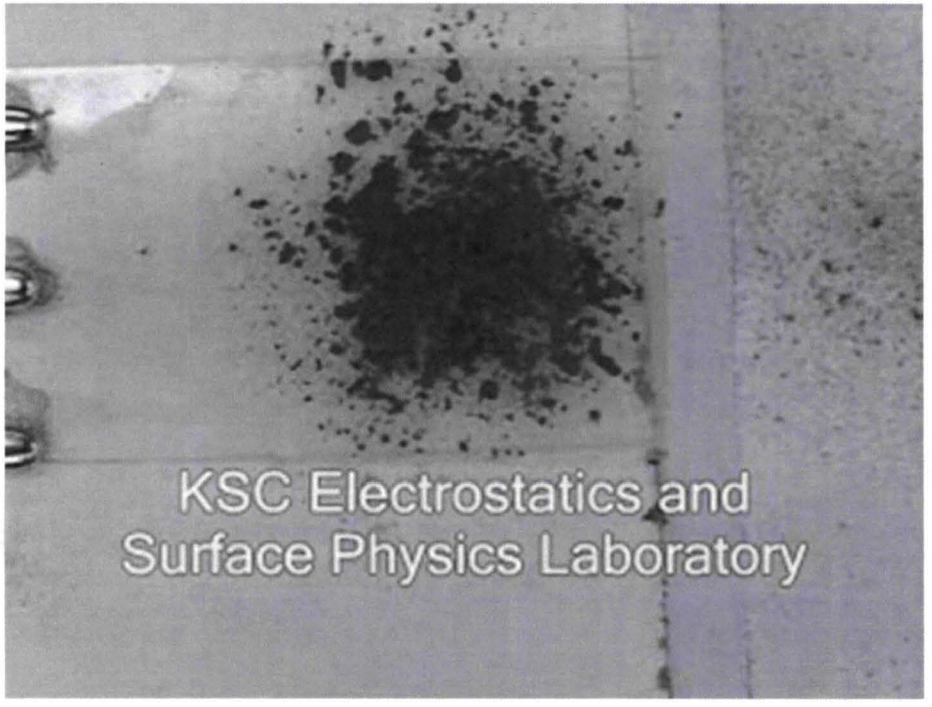
Dust Mitigation:
Electrodynamic Dust Shield
& Lotus Coating

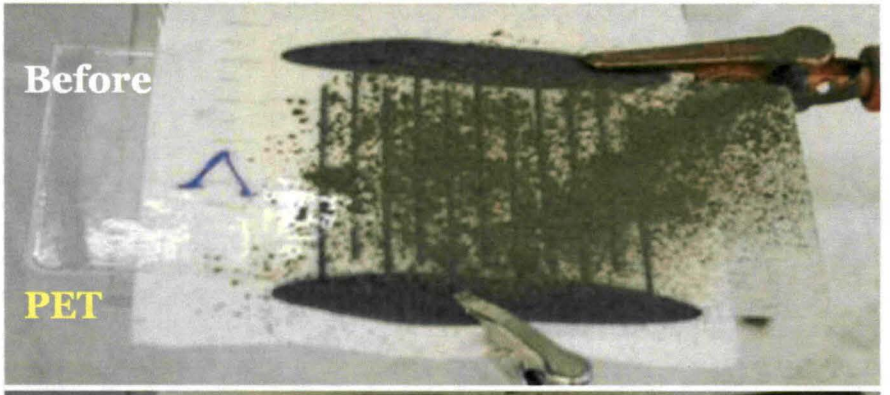


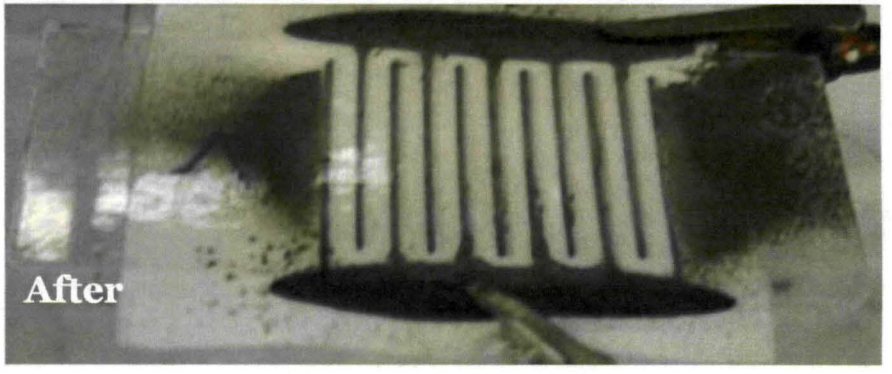
Damage
Detection
System

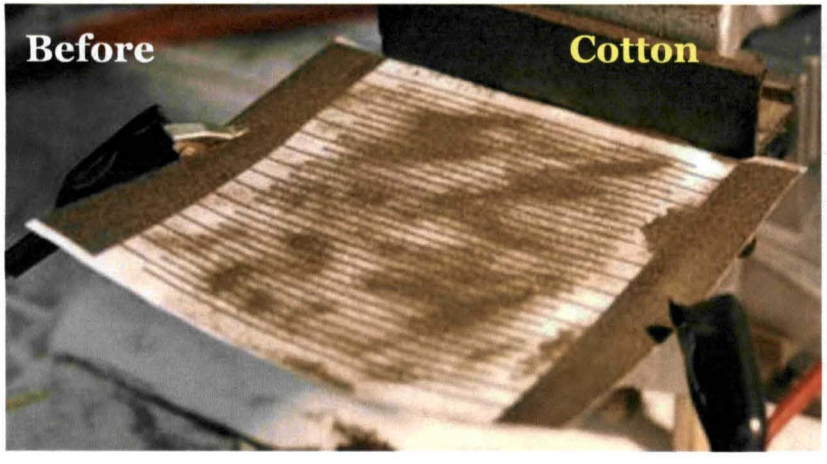
Cargo Transfer Bag
Radiation Protection
Water Walls

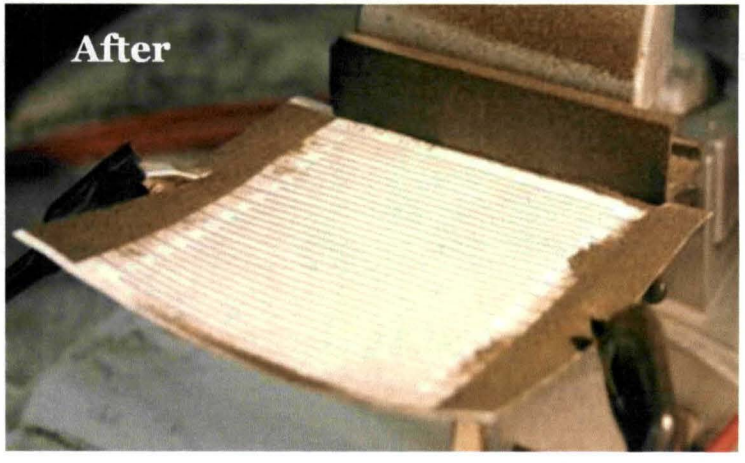
EVA Dust Shields for Space Suits and Habitats





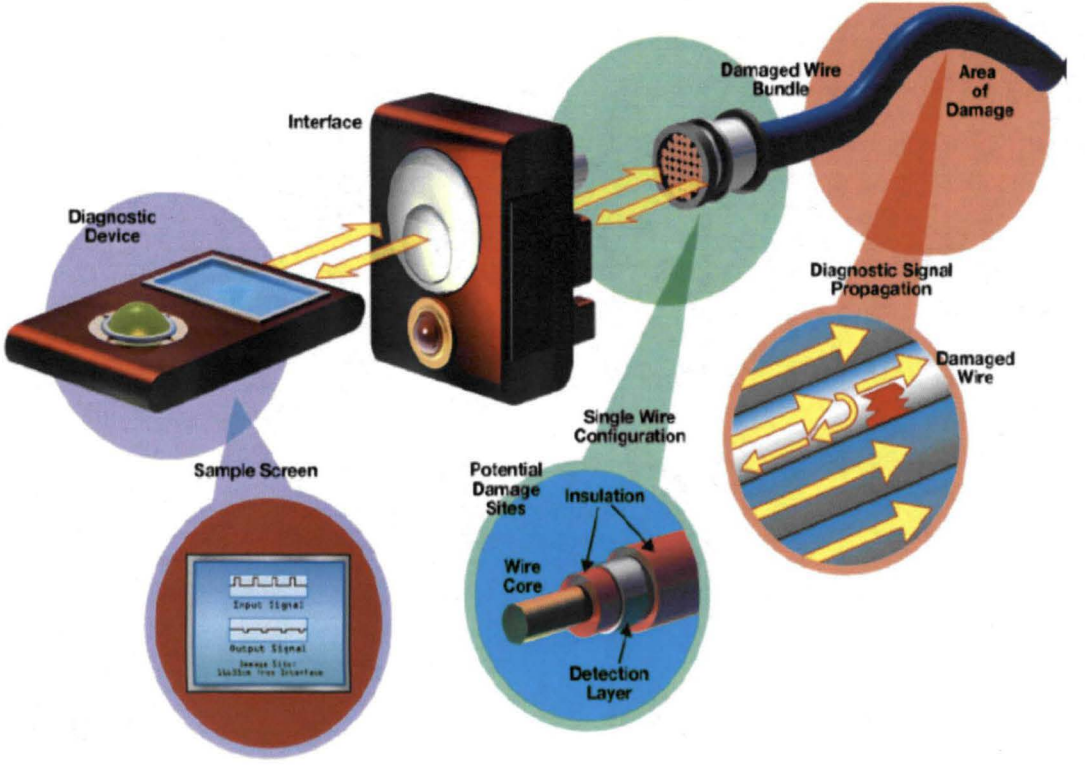


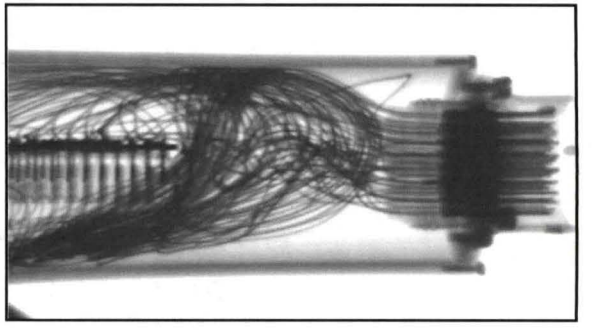




Wire Detection and Monitoring

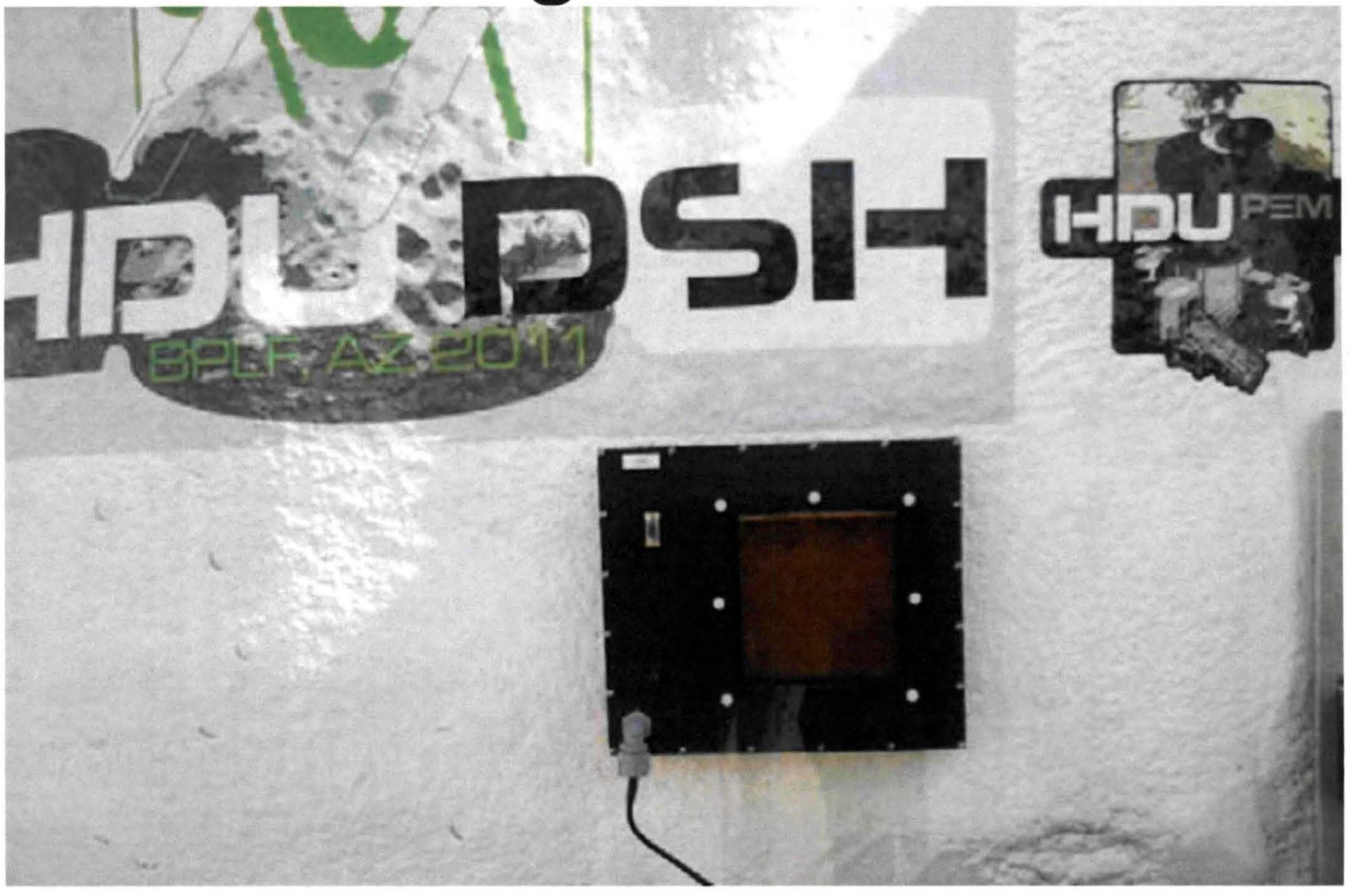
- In-situ wire damage detection system
  - Capable of wire damage detection "on-the-fly"
- Smart Connectors
  - Small, lightweight, ultra reliable
- Integrated vehicle health monitoring (IVHM)
  - System-of-systems level, providing high level of reliability





X-ray image of miniaturized TDR connector

Flat Surface Damage Detection



The Flat Surface Damage Detection system uses a series of two-dimensional detection systems and printed conductive circuitry to demonstrate a detection system for real time damage diagnosis (location and percent damage). This system will provide the ability to monitor the integrity of a composite or inflatable habitat with in situ system health monitoring.

Flat Surface Damage Detection

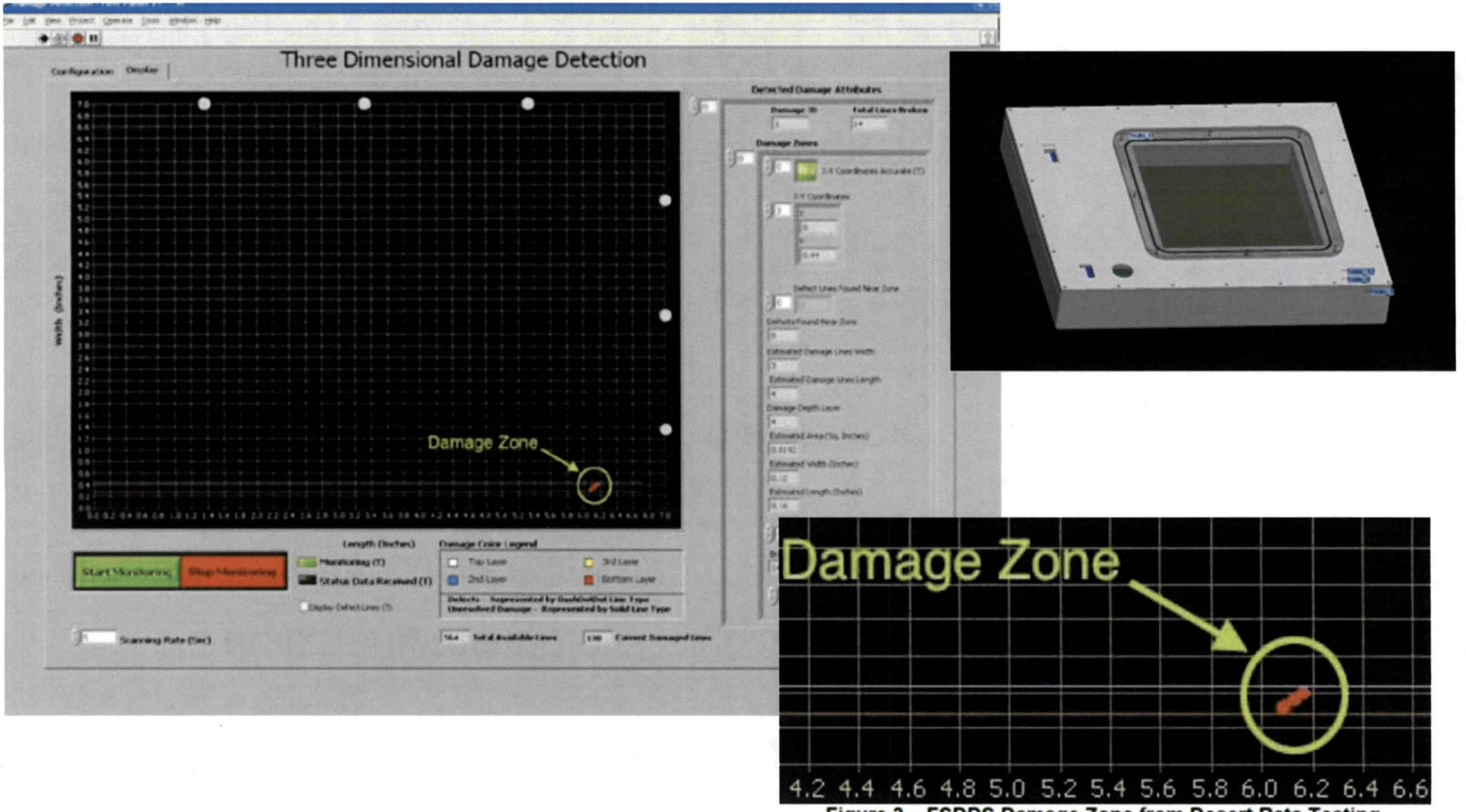


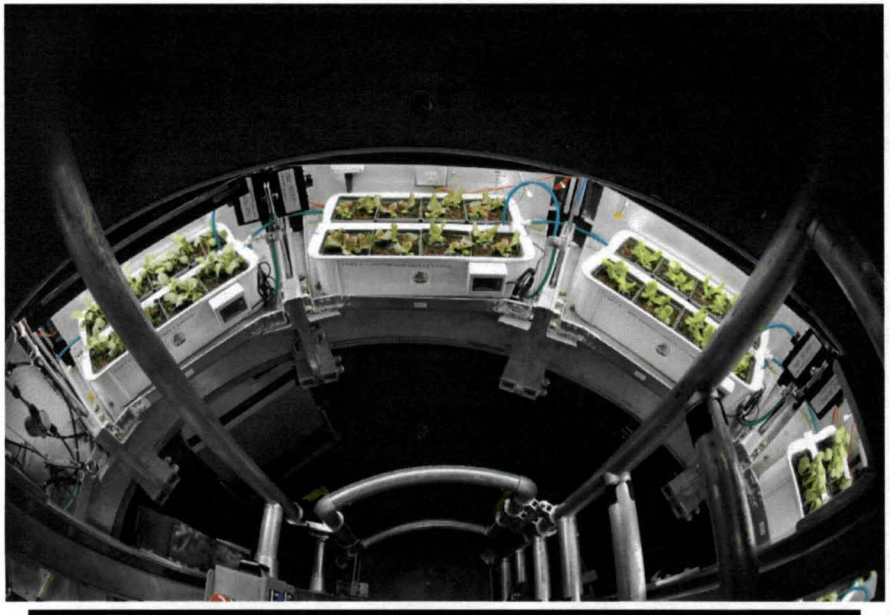
Figure 3 – FSDDS Damage Zone from Desert Rats Testing

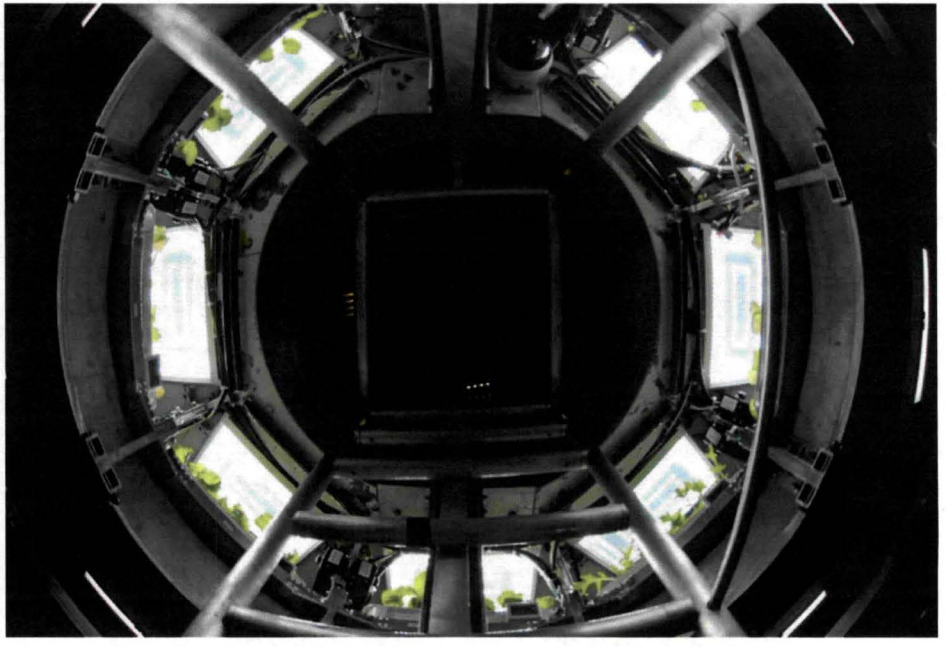
Current Areas of Life Science Research and Technology at KSC

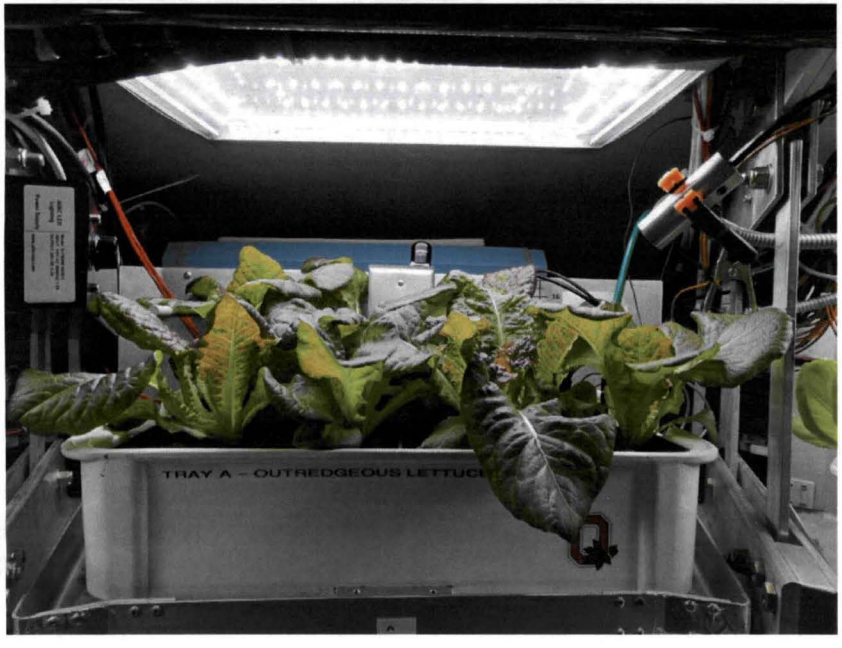
- Plant lighting technology for controlled environment agriculture
- Wastewater treatment and recycling
- Solid waste management
- Microbial risk assessment / management
- Air trace contaminant control
- Life science payload experiments
- Astrobiology (Univ. of Florida IFAS)
- Ecosystems research and management
- Medical device testing for remote medical monitoring
- Development of cryogenic life support apparatus

Food Production

Deep Space Hab Atrium in the Habitat Demonstration Unit

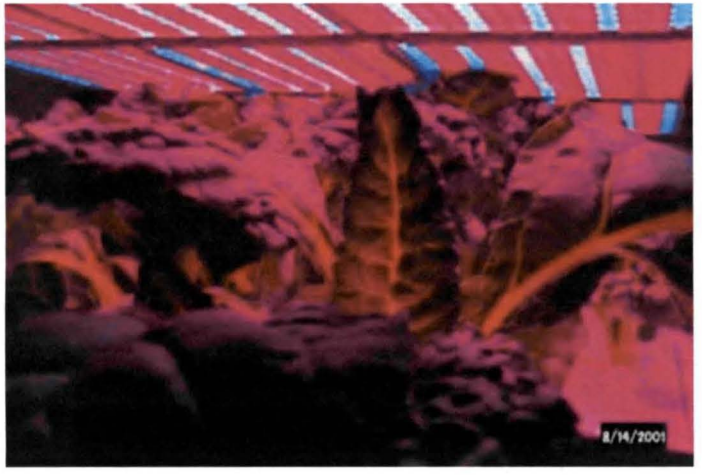


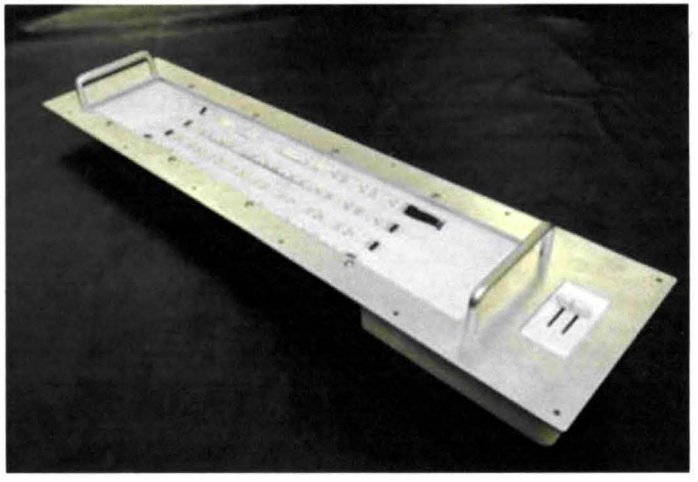


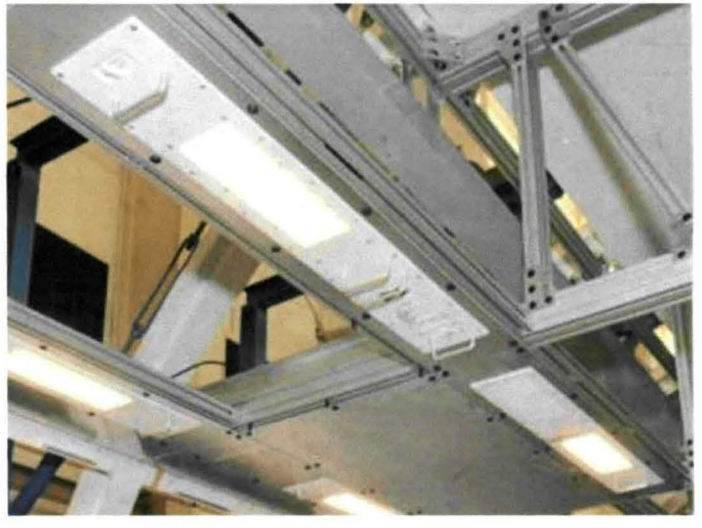


Showed how under-utilized space in a Hab could be used for plant growth to supplement diet, add psychological benefit, and assist environmental systems

LED Lighting

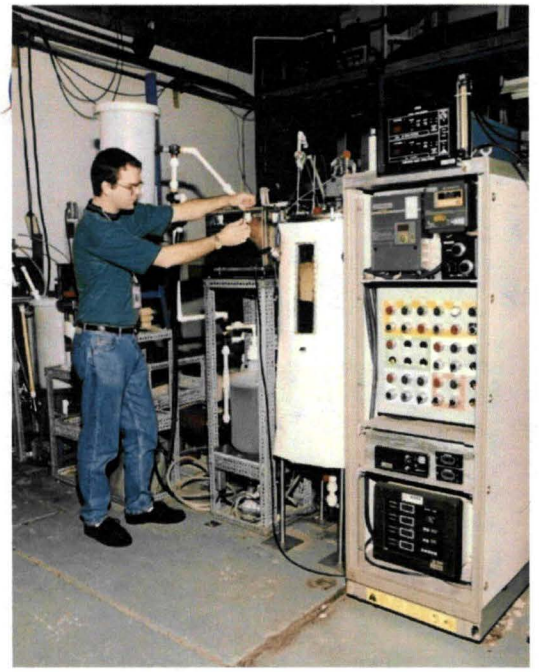




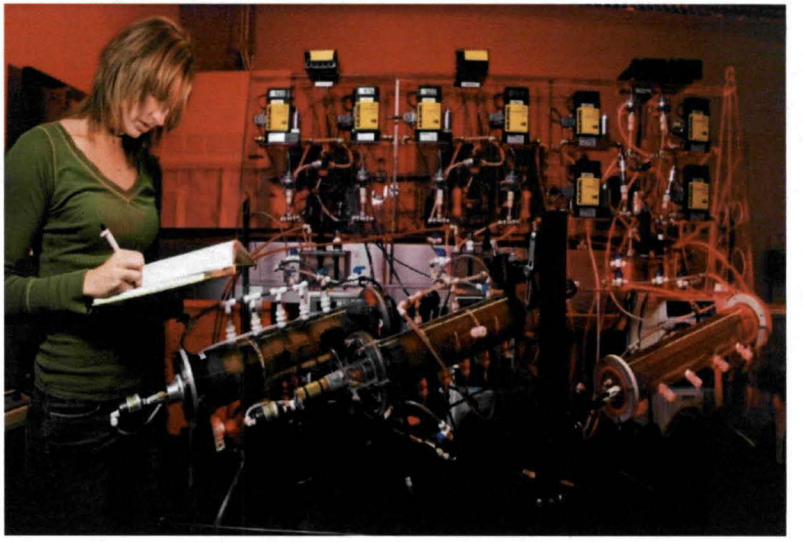


Developed pathfinding efforts in solid state lighting tailored for plant growth and developing a system to assist in circadian adaptation for crew to assist in proper sleep cycles and adjustment to variable work shifts

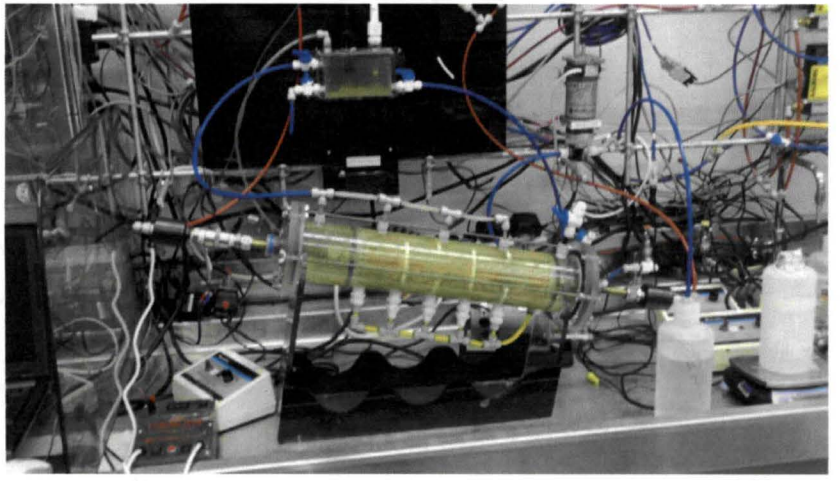
Wastewater / Solid Waste Treatment



Solid Waste Stirred Tank Reactors



Graywater and Septic Effluent Treatment

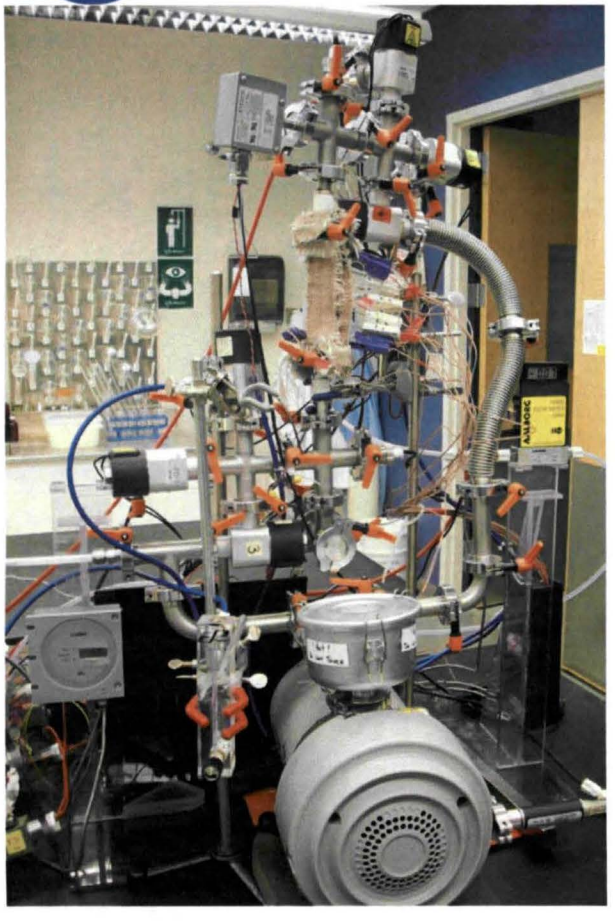


Urine Hydrolysis and Nitrification

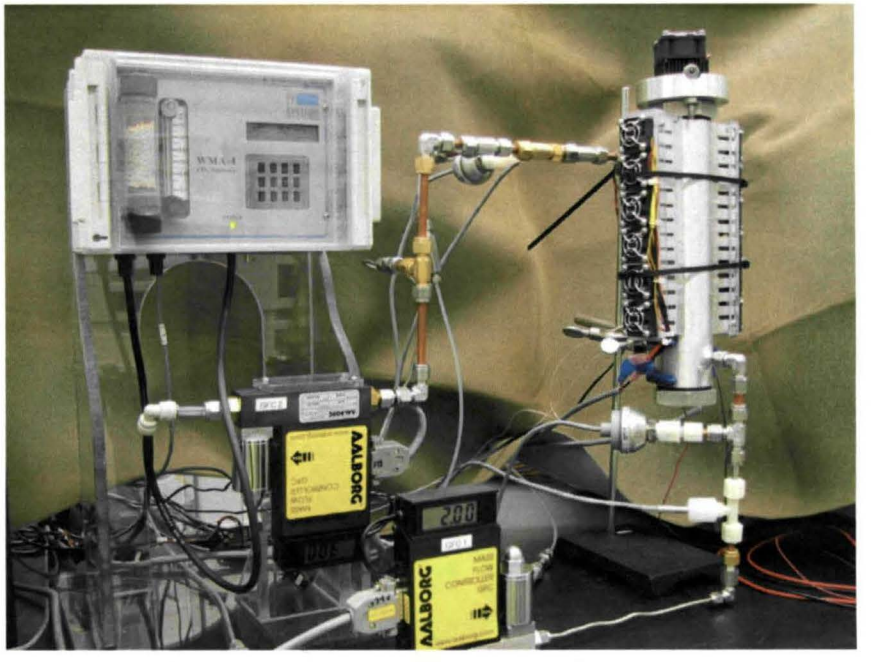
Solid Waste / Aquaculture Systems

Mackowiak et al. 1996. Acta Hort; Garland et al. 1997. Adv. Space Res.; Morales et al. 1996. FEMS Microb. Ecol. 20:155-162.

Air Trace Contaminant Control

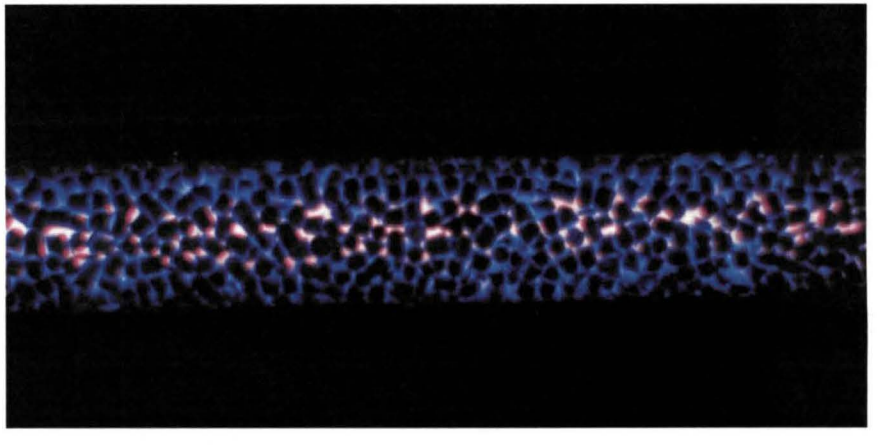


Test Bed for Regenerable Sorbents



Photocatalytic Oxidation (PCO) Test Stand

Titania Pellets Surrounding UV Lamp (PCO)

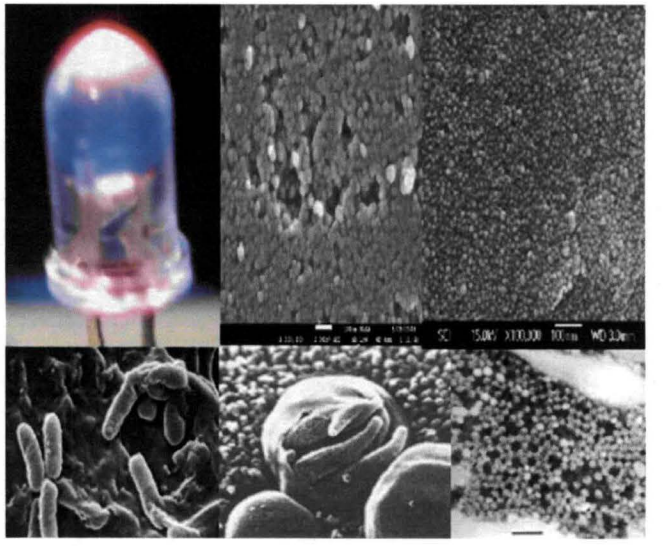


J Waste Air and Waste Mgmt. Levine et al. 2011

Microbial Risk Assessment

Lada Plant Chamber on Intl Space Station (ISS) and Food Safety

Solid Waste Retrieved from ISS

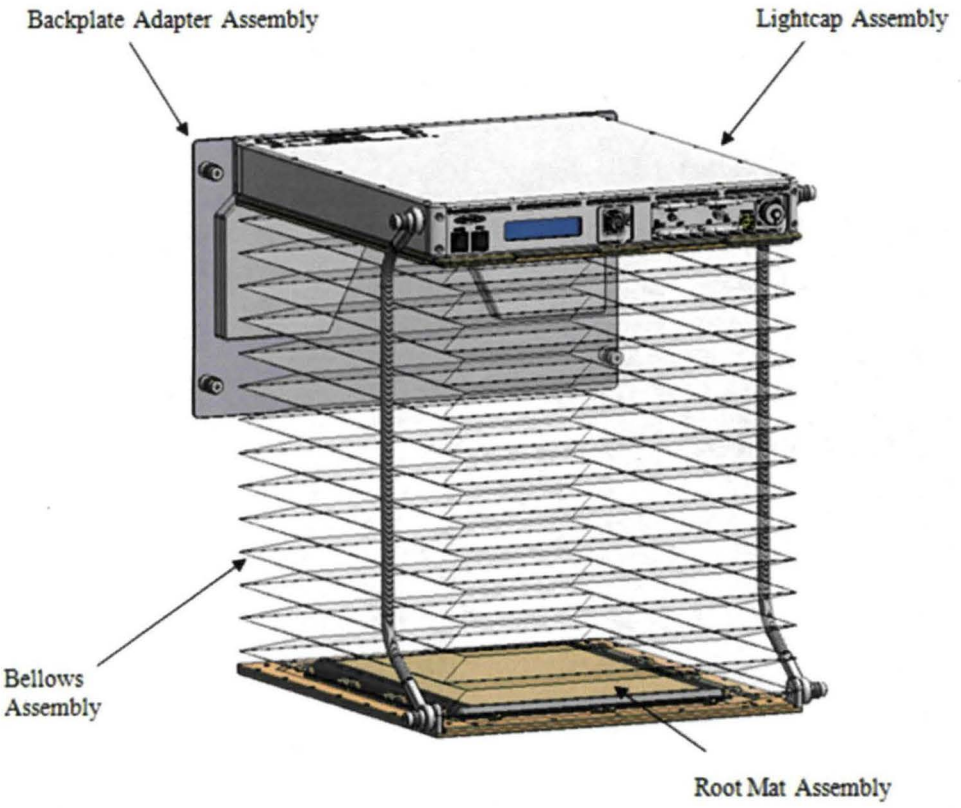


UV Radiation and Antimicrobial Materials for Potable Water

Morales et al., 1996. FEMS Microbial Ecology 20:155-162

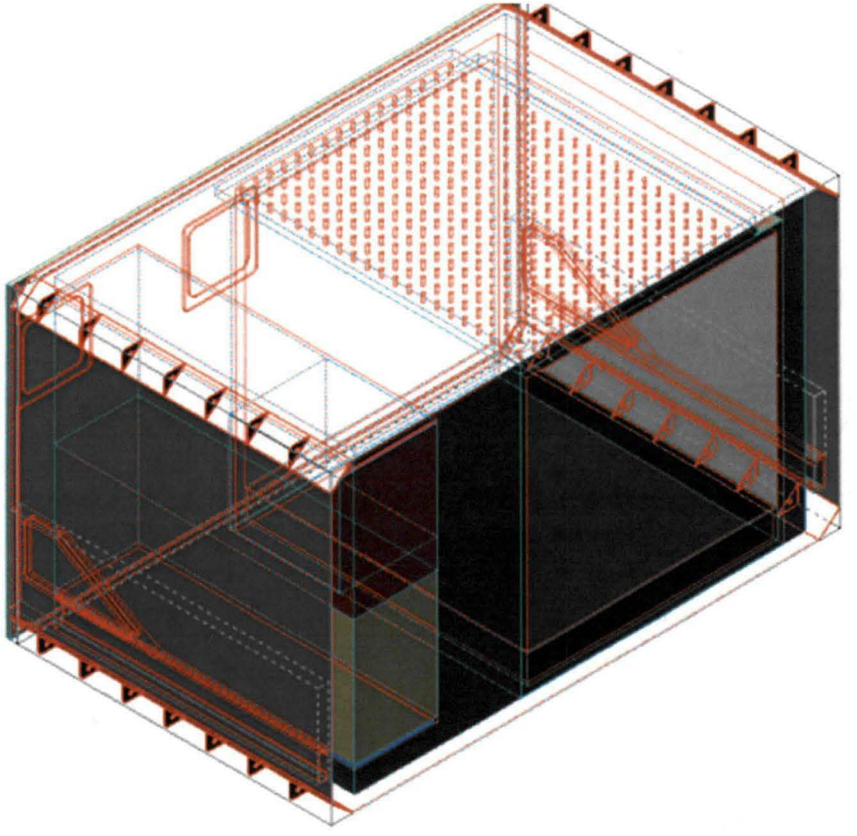
Related ISS Payload Development

Food Production Units
VEGGIE



This is a KSC developed flight payload being prepared for the ISS. The concept is to demonstrate plant growth to supplement the crew's diet with fresh, perishable foods and herbs while on exploration campaigns.

Food Production Units
Advanced Plant Habitat



- Quad-locker ISS EXPRESS rack payload under design for growing plants.
- Environmental control of humidity, temperature, lighting, CO_2, and ethylene
- Intended to be a plant growth facility for scientific customers to develop experiments.

Questions?

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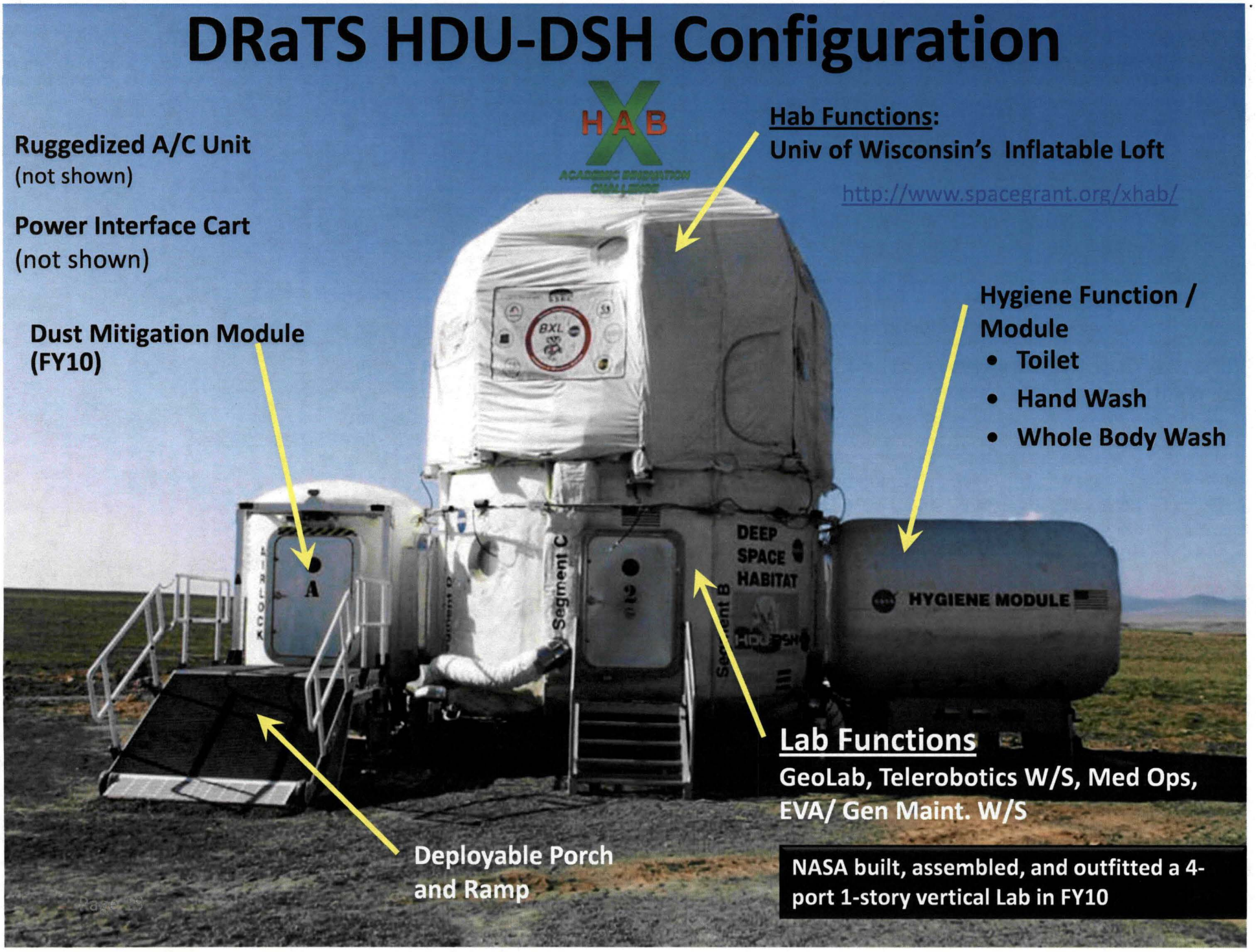
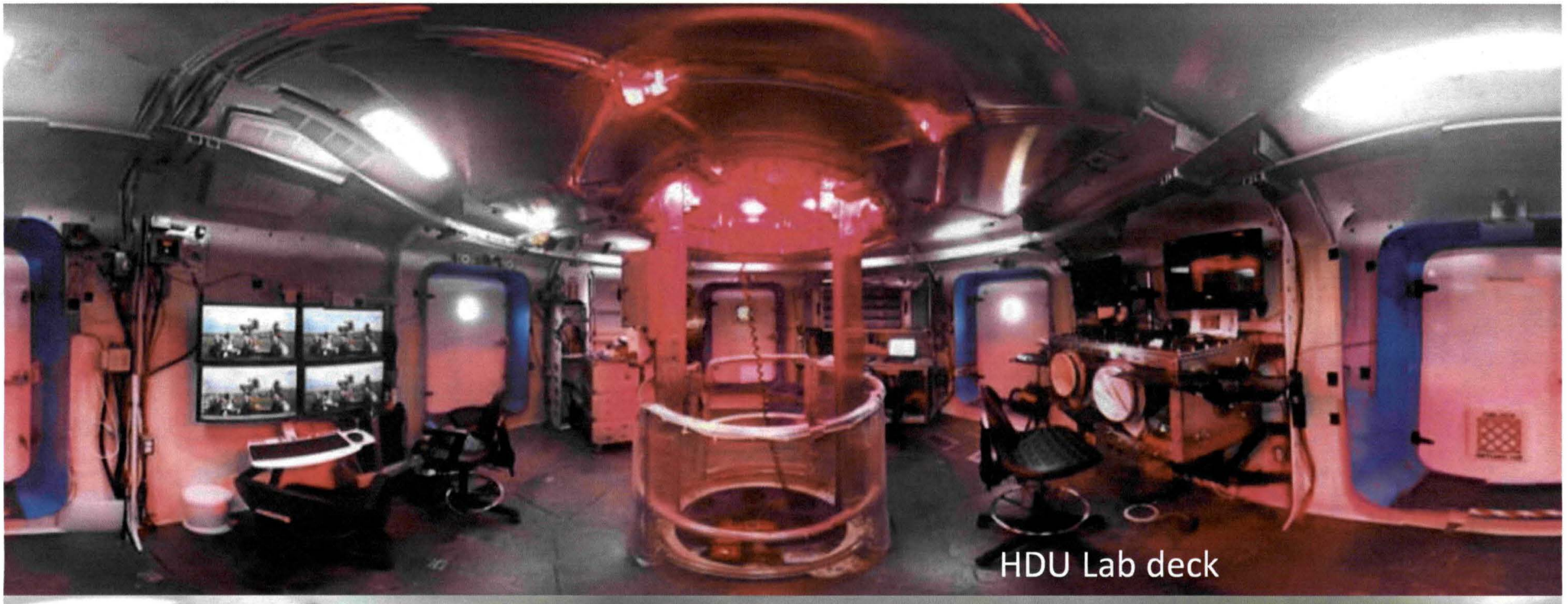
  Phone 321-867-6984
  Eirik.Holbert-1@ksc.nasa.gov

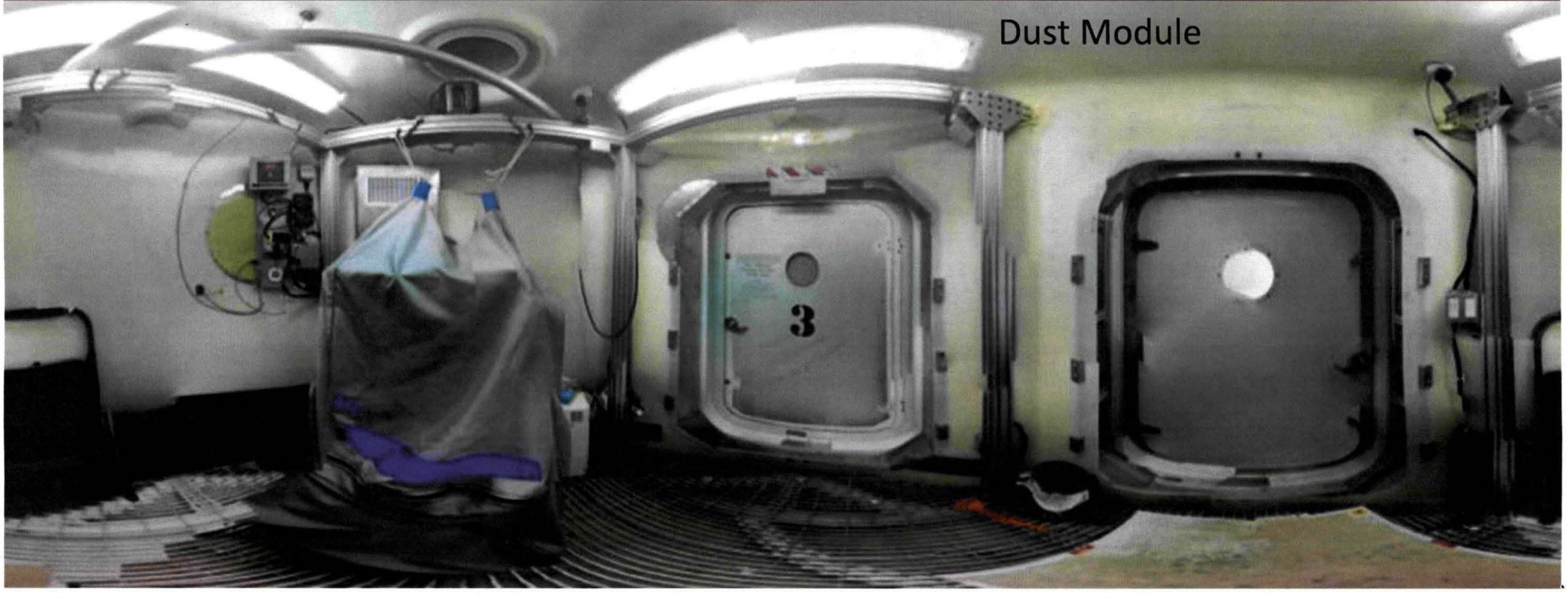
Backup Info

DRaTS HDU-DSH Configuration





HDU Lab deck



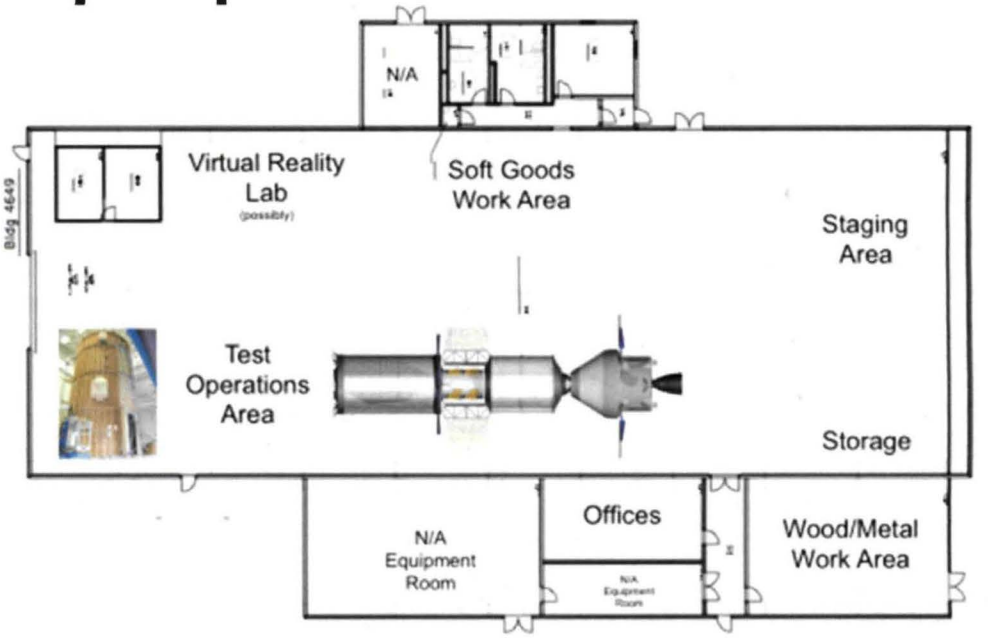
Dust Module

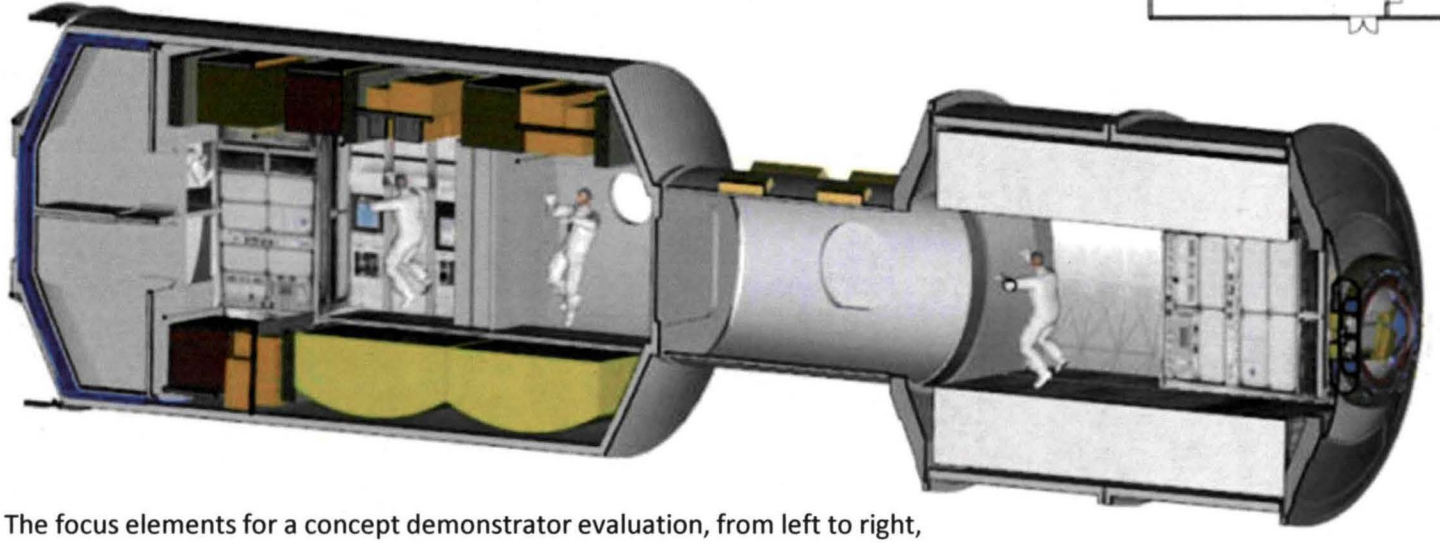
X-Hab Inflatable Loft

Hygiene Module

ISS-derived Deep Space Habitat

- The team is retiring the HDU at JSC.
- At MSFC, adding a new concept demonstrator DSH based on ISS elements being developed by our multi-center team.





The focus elements for a concept demonstrator evaluation, from left to right, Hab, tunnel, and MPLM configured as a Deep Space Habitat

Deep Space Habitat Demonstrator Evolution

ISS-derived Deep Space Habitat concept demonstrator at MSFC coming together in Building 4649, adding MPLM (right), a Node module (below), and a tunnel